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A User's Guide to the NRC's Piping Fracture Mechanics Data Base (PIFRAC)

Prepared by A. L. Hiser, G. M. Callahan

Materials Engineering Associates, Inc.

Prepared for
U.S. Nuclear Regulatory Commission

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A User's Guide to the NRC's Piping Fracture Mechanics Data Base (PIFRAC)

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ABSTRACT

This Guide is the reference for use of the NRC's Piping Fracture Mechanics Data Base (PIFRAC), a computerized data base containing the material's property data for steels used in nuclear power plant piping. These data are for use by NRC regulators and others as required for structural integrity assessments of safety margins in nuclear piping. The data of primary utility in such assessments are fracture toughness (principally J-R curve) and tensile (stress-strain) data, but other characteristic data such as chemical composition and Charpy-V data are also provided where available.

This Guide describes PIFRAC as presently configured. Revisions, updates, and corrections to PIFRAC will require revisions to this Guide.

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FOREWORD

The work reported here was performed at Materials Engineering Associates (MEA) under the program Structural Integrity of Water Reactor Pressure Boundary Components, F. J. Loss, Program Manager. The program is sponsored by the Office of Nuclear Regulatory Research of the U. S. Nuclear Regulatory Commission (NRC). The technical monitor for the NRC is Alfred Taboada.

Prior reports under the current contract are listed below:

1. J. R. Hawthorne, "Significance of Nickel and Copper to Radiation Sensitivity and Postirradiation Heat Treatment Recovery of Reactor Vessel Steels," USNRC Report NUREG/CR-2948, Nov. 1982.

2. "Structural Integrity of Water Reactor Pressure Boundary Components, Annual Report for 1982," F. J. Loss, Ed., USNRC Report NUREG/CR-3228, Vol. 1, Apr. 1983.

3. J. R. Hawthorne, "Exploratory Assessment of Postirradiation Heat Treatment Variables in Notch Ductility Recovery of A 533-B Steel," USNRC Report NUREG/CR-3229, Apr. 1983.

4. W. H. Cullen, K. Torronen, and M. Kemppainen, "Effects of Temperature on Fatigue Crack Growth of A 508-2 Steel in LWR Environment," USNRC Report NUREG/CR-3230, Apr. 1983.

5. "Proceedings of the International Atomic Energy Agency Specialists' Meeting on Subcritical Crack Growth," Vols. 1 and 2, W. H. Cullen, Ed., USNRC Conference Proceeding NUREG/CP-0044, May 1983.

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9. A. L. Hiser and F. J. Loss, "Alternative Procedures for J-R Curve Determination," USNRC Report NUREG/CR-3402, July 1983.

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12. "Structural Integrity of Light Water Reactor Pressure Boundary Components -- Four-Year Plan 1984-1988," F. J. Loss, Ed., USNRC Report NUREG/CR-3788, Sep. 1984.

13. W. H. Cullen and A. L. Hiser, "Behavior of Subcritical and Slow-Stable Crack Growth Following a Postirradiation Thermal Anneal Cycle," USNRC Report NUREG/CR-3833, Aug. 1984.

14. "Structural Integrity of Water Reactor Pressure Boundary Components: Annual Report for 1983," F. J. Loss, Ed., USNRC Report NUREG/CR-3228, Vol. 2, Sept. 1984.

15. W. H. Cullen, "Fatigue Crack Growth Rates of Low-Carbon and Stainless Piping Steels in PWR Environment," USNRC Report NUREG/CR-3945, Feb. 1985.

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21. J. R. Hawthorne, "Exploratory Studies of Element Interactions and Composition Dependencies in Radiation Sensitivity Development," USNRC Report NUREG/CR-4437, Nov. 1985.

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26. "Structural Integrity of Water Reactor Pressure Boundary Components: Annual Report for 1985," F. J. Loss, Ed., USNRC Report NUREG/CR-3228, Vol. 4, June 1986.

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Prior reports dealing with the specific topic of this report are listed below:

A. L. Hiser, "Piping Fracture Mechanics Data Base," in Proceedings of the U. S. Nuclear Regulatory Commission Fourteenth Water Reactor Safety Information Meeting, USNRC Conference Proceedings NUREG/CP-0082, Vol. 2, Feb. 1987, pp. 419-432.

A. L. Hiser, "Piping Fracture Mechanics Data Base," in Proceedings of the U. S. Nuclear Regulatory Commission Thirteenth Water Reactor Safety Information Meeting, USNRC Conference Proceedings NUREG/CP-0072, Vol. 2, Feb. 1986, pp. 321-336.

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1. INTRODUCTION

The NRC's Piping Fracture Mechanics Data Base (PIFRAC) was initiated to provide to NRC regulators and others the material's property data for steels used in nuclear power plant piping, as required for structural integrity assessments of safety margins in nuclear piping. The data of primary utility in such assessments are fracture toughness (principally J-R curve) and tensile (stress-strain) data, but other characteristic data such as chemical composition and Charpy-V data are also provided where available.

PIFRAC is intended to be all-encompassing, in terms of the variety of materials and number of heats represented. As such, a target list of materials has been established (Ref. 1), as determined from a survey of Final Safety Analysis Reports (FSAR's) for operating or planned plants. With this list as the target, data from the literature are being supplemented by additional testing at MEA, with the goal of providing as many data as possible for as many materials and heats as possible.

In its final form, PIFRAC is a computerized data base, with remote accessibility for outside users. The current data base software provide a menu-driven search capability, whereby users can query the system to extract the data required by their applications. This Guide serves as a reference to the link from the user to the search system, to provide the user with expected input and output parameters, along with other information which may be useful.

Data base access privileges can be obtained from M. Vagins of the NRC's Office of Nuclear Regulatory Research at 301/443-7905. There will be a nominal charge to access the data base.

Specific data types available in PIFRAC include:

(a) J-R curve: using deformation J (J_D) and modified J (J_M)

(b) Tensile: true and engineering stress-strain

(c) Impact: Charpy-V energy, etc.

(d) Reference Information: chemical composition, bibliographic, etc.

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2. NOMENCLATURE OF THIS GUIDE

For ease of use, this Guide has a certain format to identify user inputs and computer responses, along with some simplying notations:

(1) User inputs are represented in **BOLDFACE**.

(2) Computer prompts or responses are in ***BOLDFACE ITALICS***.

(3) A RETURN key strike is indicated by **<RET>**.

(4) A caret (>) or a question mark (*?*) from the computer is required for all inputs. (At pauses, an input is requested by a prompt of "***PRESS ANY KEY***".)

When a question is posed followed by an appropriate response in parenthesis, the indicated response represents the default response. Other responses can also be given.

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3. LOG-IN PROCEDURES

The expectant user should have at his disposal file access parameters supplied by MEA. These parameters can be obtained through M. Vagins of the NRC's Office of Nuclear Regulatory Research at 301/443-7905.

Virtually any type of terminal can be used for accessing the data base. The computer on which the data base resides is a Digital Equipment Corporation (DEC) PDP 11/44. Therefore, a VT-100 terminal or emulator will give the best results, but even a line printer can be used. The parameter sheet for the HAYES SMARTCOM II package in Fig. 1 demonstrates one successful set-up for accessing PIFRAC. Key parameters are 1200 baud with full duplex. Regular telephone lines can be used; the phone number is 301/577-3766.

Once the modem link has been established, the sequence needed to log-in and access the PIFRAC software is given in Fig. 2. When the caret is sent by the computer, the user should input "**HEL**" followed by a space and the account number, followed by **<RET>**. The computer will respond with a request for the "*PASSWORD:*", to which the user should key in the proper password, followed by **<RET>**. If a valid account has been accessed by a valid password, then several lines will be printed along with a salutation, followed by a caret. At this point, the user should input "**@PIFRAC <RET>**". The response will be the VT-100 query given in Fig. 2. A positive response that a VT-100 terminal or emulator is in use is achieved by a simple **<RET>**, while a line printer or other emulator can be specified by an input of "**N <RET>**".

At this point, the data base search system has been accessed.

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PARAMETERS

Name of Set: 0 - MODEM TO DEC 11/4400 Press F2 For Help

TRANSMISSION PARAMETERS

Duplex:	FULL
Connection Type:	Bell 1200
Character Processing:	FORMATTED
Show Control Codes:	NO
Page Pause:	NO
Show Status Lines:	NO
Confidential:	NO
Include Line Feeds:	NO
Character Delay:	0 (0.001 sec.)
Line Delay:	0 (0.01 sec.)
Character Format:	7 DATA + ODD + 1 STOP
Emulator:	VT102 / VT100

TELEPHONE PARAMETERS

Answer On Ring:	1
Remote Access:	NONE Password:
Phone Number:	577-3766

KEYBOARD DEFINITIONS

Escape Key:	128 (F1)
Help Key:	129 (F2)
Printer Key:	130 (F3)
Capture Key:	131 (F4)
Macro Prefix Key:	132 (F5)
Break Key:	133 (F6)
Break Length:	35 (0.01 sec.)
Protect Key:	134 (F7)

PROTOCOL PARAMETERS

Receive Time-out:	60 (sec.)
Send Time-out:	10 (sec.)
Error-Free Protocol:	HAYES
Stop/Start- Stop Char:	19 (DC3)
Start Char:	17 (DC1)
Send Lines- EOL Char:	10 (LF)
Prompt Char:	63 ("?")

Fig. 1 Parameter sheet for the HAYES SMARTCOM II package which successfully accesses PIFRAC.

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```
x
MCR -- Not logged in
>HEL 100,1
Password:

RSX-11M BL35   [1,54] System      MEA
17-FEB-87 13:28 Logged on Terminal TT5:

Good Afternoon

>@PIFRAC
Are you using a VT100? (YES) ?
```

Fig. 2 The log-in sequence is illustrated here. Successful execution of the log-in results in routing to the main menu.

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4. SEARCH SYSTEM PROCEDURES

PIFRAC is a menu-driven system, with each menu given a unique "Screen" number in the upper right side of the menu. This Guide is likewise keyed to the Screen number with descriptions of each option from the menu given along with direction to succeeding screens the user will see. In general, data listing screens can be terminated by pressing the "X" key.

In PIFRAC, each heat has been assigned a unique "Reference number," usually indicated by "REF". Therefore, data listings will usually give only the "REF" number as an identifier of the particular material, product form, etc.

"Downloading" of data into the user's storage media (generally a disk file) is an option given before all data listings [the software prompt is "*ARE YOU GOING TO SAVE THIS LISTING IN A FILE (NO)?*"]. Procedures for downloading are given on page 11.

A description of each menu follows. The top section of each page gives the display seen by the user for each screen.

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P I F R A C

This is the NRC's Piping Fracture Mechanics Data Base.

The last data update was made on 14-Jan-87 at 11:00.

MAIN MENU

Select an option:

0) QUIT.
1) ACCESS the PIFRAC DB search system.
2) CHECK on updates.
3) Choose Metric/English.

Your choice?

****

This is the "Main Menu" of PIFRAC. The listed selections result in the following:

(0) Exits PIFRAC.

(1) Accesses the PIFRAC search system. Proceed to Screen 1.

(2) Allows the user to check data file and program updates. Proceed to Screen 17.

(3) Allows the user to change from a default condition of Metric (mm, °C, MPa, etc.) input and output to English (in., °F, ksi, etc.) input and output. Selection of this option is illustrated on the next page.

To make a selection, input the number followed by <RET>. (Any input of a letter "<RET>" results in an exit from PIFRAC.)

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UNITS SELECTION

```
                                MAIN MENU

Select an option:

     0) QUIT.
     1) ACCESS the PIFRAC DB search system.
     2) CHECK on updates.
     3) Choose Metric/English.


Your choice? 3

The current system is Metric.
Would you rather use English? (NO) ?
```

****

Units selection (Option 3 from the Main Menu) is illustrated here. Default units are Metric, with a response of "Y <RET>" sufficient to change to English units. Routing is then back to the Main Menu.

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DOWNLOADING DATA

After you have read these instructions, hit <BREAK> twice to go off-line. This page will disappear as soon as you do that.
Press <F1> to return to the main menu of the emulator.
Press 4 to receive file.
Press <RET> to select Stop/Start protocol. Enter the file name.
Press <RET> to go back on line.
Press <RET> to begin transmission.

Press a key when ready to receive file.

****

After many of the data listing options have been selected, the initial prompt is as given above, asking "*ARE YOU GOING TO SAVE THIS LISTING IN A FILE (NO)?*".

If the user does not want a file copy of the listing, a response of <RET> results in display only of the data.

To obtain a file copy, the user must input "Y <RET>" to the initial prompt. The PIFRAC response will be headed by "*DOWNLOADING DATA*". The information listed thereafter applied to the HAYES SMARTCOM II emulator package only.

In general, the sequence required for downloading data is as follows:

(a) Press <BREAK> twice to go off-line.

(b) Set up at your terminal to "receive file". Enter the file name or any other parameters required.

(c) Go back on-line to PIFRAC.

(d) Press <RET> to begin the data transfer.

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SCREEN 1

Screen 1

PIFRAC Data Base Search System

Select an option:

0) QUIT.
1) LIST reference number, material type, specification, and form.
2) LIST reference number, title, authors, affiliations, material type, specification, and form.
3) SEARCH for a known material type.
4) SEARCH for a known specification.
5) CHOOSE reference numbers directly.
6) RETURN to main menu.

Your choice?

****

Screen 1 of PIFRAC is used to select the method for determining the reference numbers of appropriate heats. The indicated options result in the following:

(0) Exits PIFRAC.

(1) Lists the indicated information to permit a user to see which heats data are available for. Proceed to Screen 2.

(2) Lists the indicated information for the available heats. Proceed to Screen 3.

(3) Allows the user to select appropriate heats based upon the material type (carbon, stainless, etc.). Proceed to Screen 4.

(4) Allows the user to select the specification pertinent to his application. Proceed to Screen 5.

(5) Allows the user to directly access appropriate heats for which the reference numbers are known. Proceed to Screen 6.

(6) Returns to the Main Menu.

To make a selection, input the appropriate number followed by <RET>. (An input of "X <RET>" exits PIFRAC.)

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SCREEN 2

Screen 2

1 : CARBON STEEL
SA106 GRADE B
6 in. (152 mm) SCH 40 PIPE

2 : CARBON STEEL
SA106 GRADE B
6 in. (152 mm) SCH 120 PIPE

3 : STAINLESS STEEL
SA182-TYPE 304
20 in. (508 mm) SCH 100 PIPE

4 : STAINLESS STEEL (SAFE END)
SA376-TYPE 304
6 in. (152 mm) SCH 120 PIPE

5 : STAINLESS STEEL
SA376-TYPE 304
6 in. (152 mm) SCH 40 PIPE

Press a key to continue.

****

For each heat (reference number to the left), the general material type, appropriate specification, and product form (including pipe dimensions) are listed to allow tne user to see the characteristics of the available heats. As indicated, pressing any key (except "X") scrolls to the next list of heats, with a return to Screen 1 after all heats have been listed. An input of "X" returns to Screen 1 immediately.

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SCREEN 3

Screen 3

1

MATERIALS ENGINEERING ASSOCIATES, INC.
CARBON STEEL
SA106 GRADE B
6 in. (152 mm) SCH 40 PIPE

2

MATERIALS ENGINEERING ASSOCIATES, INC.
CARBON STEEL
SA106 GRADE B
6 in. (152 mm) SCH 120 PIPE

Press a key to continue.

****

Bibliographic and heat characteristics information are listed here. Pressing any key (except "X") scrolls to the next few heats, with a return to Screen 1 once all heats have been listed. An input of "X" returns to Screen 1 immediately.

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Screen 4

Choose materials

1) CARBON STEEL
2) STAINLESS STEEL
3) STAINLESS STEEL (SAFE END)
4) CAST STAINLESS STEEL
5) INCONEL
6) STAINLESS STEEL WELD

Enter the number of the material you want to select.
Enter the negative of the same number to "un-select" the material.
Just press <RET> when you are finished, or an X to return to screen 1.

Your choice?

General material types are chosen here. As indicated, to select a listed material type the user should input the appropriate number followed by <RET>. (Example: "1 <RET>" selects carbon steels.) To delete an improper selection, input the negative of the number followed by <RET>. (Example: if carbon steel was an improper selection, input "-1 <RET>" to delete that selection.) As many selections as desired can be made, with only one entry per line. Once the proper selections have been made, just press <RET> (with no input) to proceed to Screen 7.

At all times, an input of "X <RET>" returns to Screen 1.

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SCREEN 5

Screen 5

Choose specifications

1) SA106 GRADE B
2) SA182-TYPE 304
3) SA376-TYPE 304
4) SA351-CF8A
5) INCONEL 600
6) TYPE 304, SA WELD
7) TYPE 304
8) TYPE 304, TIG WELD
9) SA106 GRADE C

Enter the number of the specification you want to select.
Enter the negative of the same number to "un-select" the specification.
Just press <RET> when you are finished, or enter an X to return to screen 1.

Your choice?

****

Appropriate specifications are chosen here. As indicated, a specification is selected by an input of the appropriate number followed by <RET>. (Example: "5 <RET>" selects Inconel 600.) To delete an improper selection, input the negative of the number followed by <RET>. (Example: "-5 <RET>" deletes the selection of Inconel 600.) As many selections as desired can be made, with only one entry per line. Once the proper selections have been made, just press <RET> (with no input) to proceed to Screen 7.

At all times, an input of "X <RET>" returns to Screen 1.

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SCREEN 6

Screen 6

Choose reference numbers

Do you want all of them? (NO) ?

Enter the reference number you want to select.
Enter the negative of the number to "un-select" it.
Just press <RET> when you are finished, or enter an X to return to screen 1.

Your choice?

****

If appropriate reference numbers are known for the heats of interest, then the heats can be selected here. To select all heats, input "Y <RET>" to the initial prompt. Then proceed to Screen 8.

If all heats are not desired, then press <RET> (with no input) to the initial question. With the computer response of "*YOUR CHOICE*" , input the appropriate reference number followed by <RET> to select the reference number (Example: "1" <RET>" selects reference number 1.). To delete an improper selection, input the negative of the reference number followed by <RET>. (Example: "-1 <RET>" deletes reference number 1 as a selection.) As many selections as desired can be made, with only one entry per line. Once the proper selections have been made, press <RET> (with no input) to proceed to Screen 7 to view characteristics of the chosen heats.

At all times, an input of "X <RET>" returns to Screen 1.

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Screen 7

```
 1 : CARBON STEEL
     SA106 GRADE B
     6 in. (152 mm) SCH 40 PIPE

 6 : CAST STAINLESS STEEL
     SA351-CF8A
     32 in. (813 mm) x 2.2 in. (57 mm) PIPE

14 : STAINLESS STEEL WELD
     TYPE 304, TIG WELD
```

That's it.
Press a key when ready to go to screen 8.

****

Once appropriate reference numbers have been determined from Screens 4, 5, or 6, characteristics of the selected heats are displayed here.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of heats. An input of "X" at this time proceeds to Screen 8. If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key except "X" proceeds to Screen 8.

If the user is not satisfied with the selected heats, then an input of "X <RET>" in response to the "*THAT'S IT*" prompt returns to Screen 1 for further consideration.

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Screen 8

What do you want to do next?

0) QUIT.
1) LIST Compositions.
2) LIST Authors and their affiliations.
3) LIST All REF data except composition.
4) ACCESS TENSILE data.
5) ACCESS Cv data.
6) ACCESS J-R data.
7) RETURN to main menu.

Your choice?

****

Once the proper heats have been determined, data from each can be accessed from this menu. The indicated options result in the following:

(0) Exits PIFRAC.

(1) Lists the chemical compositions (Wt-%) for each heat. Proceed to Screen 9.

(2) Lists authors and their affiliations for each heat. Proceed to Screen 10.

(3) Lists all of the reference-type information, except for chemical composition. Proceed to Screen 11.

(4) Accesses tensile data. Proceed to Screen 12.

(5) Accesses Charpy-V data. Proceed to Screen 13.

(6) Accesses J-R curve data. Proceed to Screen 14.

(7) Returns to the Main Menu.

To make a selection, input the appropriate number followed by <RET>. Input of "X <RET>" results in an exit from PIFRAC.

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SCREEN 9

Screen 9

REF	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	Ti
1	0.180	0.720	0.200	0.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.830	0.028	0.026	0.290	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	1.140	0.017	0.009	0.430	9.810	18.920	0.290	0.160	0.004	0.000
4	0.058	1.530	0.019	0.014	0.480	9.300	18.740	0.150	0.000	0.000	0.000
5	0.000	1.740	0.020	0.011	0.410	10.430	19.230	0.220	0.000	0.000	0.000
6	0.000	0.660	0.020	0.018	1.170	8.580	20.420	0.000	0.000	0.000	0.000
10	0.000	1.010	0.022	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.030	0.350	0.000	0.003	0.200	75.010	15.530	0.058	0.023	0.000	0.250

REF	Al	Co	W	As	Sn	Zr	Nb	Sb	Zn	N
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.064
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.065
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.150	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Press a key to continue.

****

For each selected heat, the chemical composition in wt-% of various important elements is listed here. Additional screens will be printed if more than eight heats have been selected.

If the bottom line prompt is "***PRESS A KEY TO CONTINUE***", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 8.

If all of the data have been displayed (indicated by a prompt of "***THAT'S IT***"), then pressing any key returns to Screen 8.

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Screen 10

```
REF #: 8
AUTHORS:
AFFILIATIONS: MATERIALS ENGINEERING ASSOCIATES, INC.

REF #: 10
AUTHORS:
AFFILIATIONS: MATERIALS ENGINEERING ASSOCIATES, INC.

REF #: 11
AUTHORS:
AFFILIATIONS: MATERIALS ENGINEERING ASSOCIATES, INC.

REF #: 12
AUTHORS: LANDES,J.D.; MCCABE,D.E.
AFFILIATIONS: FORMERLY WESTINGHOUSE R&D CENTER

REF #: 13
AUTHORS: LANDES,J.D.; MCCABE,D.E.
AFFILIATIONS: FORMERLY WESTINGHOUSE R&D CENTER
                                                    Press a key to continue.
```

****

For each selected heat, the author(s) and their affiliations are listed.

If the bottom line prompt is "***PRESS A KEY TO CONTINUE***", then pressing any key (except "**X**") results in a scroll to the next list of data. An input of "**X**" at this time returns to Screen 8.

If all of the data have been displayed (indicated by a prompt of "***THAT'S IT***"), then pressing any key returns to Screen 8.

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SCREEN 11

```
REF #: 12                                                    Screen 11
TITLE: TOUGHNESS CHARACTERIZATION OF AUSTENITIC STAINLESS STEEL PIPE WELDMENTS
AUTHORS: LANDES,J.D.; MCCABE,D.E.
AFFILIATIONS: FORMERLY WESTINGHOUSE R&D CENTER
REFERENCE:
SPONSOR:          ELECTRIC POWER RESEARCH INSTITUTE
CONTRACT:
DATE:
REMARKS:
MATERIAL TYPE:    STAINLESS STEEL WELD
SPECIFICATION:    TYPE 304, SA WELD
PRODUCT FORM:
MANUFACTURER:
HEAT NUMBER:      A, WELD
ANALYSIS CODE:
THERMO:
GRAIN SIZE:   0     % FERRITE:   0.0    LOCATION THRU THICKNESS:
HARDNESS/SCALE:                              0.0
                                             0.0
                                             0.0
                                             0.0
                                             0.0

                                        Press a key to continue.
```

For each selected heat, reference-type information is displayed, one heat per screen.

If the bottom line prompt is "***PRESS A KEY TO CONTINUE***", then pressing any key (except "**X**") results in a scroll to the next heat. An input of "**X**" at this time returns to Screen 8.

If all heats have been displayed (indicated by a prompt of "***THAT'S IT***"), then pressing any key returns to Screen 8.

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SCREEN 12

Screen 12

Select an option:

1) LIST strength values only.
2) LIST Ramberg-Osgood values only.
3) LIST all summary data.
4) LIST stress-strain data.
5) RETURN to main menu.
6) RETURN to screen 8.

Your choice?

Tensile data are accessed from this menu. The listed options result in the following:

(1) Lists yield and ultimate strength values, percent elongation, and percent reduction of area for each test. Proceed to Screen 23.

(2) Lists Ramberg-Osgood parameter values for each test. Proceed to Screen 24.

(3) Lists all of the summary-type of information for each test. Proceed to Screen 25.

(4) Lists engineering and true stress-strain data for each test. Proceed to Screen 26.

(5) Returns to the Main Menu.

(6) Returns to Screen 8.

To make a selection, input the appropriate number followed by <RET>.

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SCREEN 13

Screen 13

Select an option:

1) LIST energy, percent shear, and lateral expansion.
2) LIST all data.
3) LIST all specimen details, etc. (not yet available)
4) RETURN to main menu.
5) RETURN to screen 8.

Your choice?

Charpy-V data are accessed from this menu. The listed options result in the following:

(1) Lists standard C_v results, i.e., absorbed energy, percent shear, and lateral expansion. Proceed to Screen 27.

(2) Lists all of the data available for each specimen. Proceed to Screen 28.

(3) Not available yet. Returns to Screen 13.

(4) Returns to the Main Menu.

(5) Returns to Screen 8.

To make a selection, input the appropriate number followed by <RET>.

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SCREEN 14

Screen 14

Select an option:

1) LIST basic specimen details.
2) LIST summary results.
3) LIST J-Delta a data.
4) LIST all J-R curve test data.
5) ACCESS test system parameters. (not yet available)
6) LIST all specimen details.
7) SELECT specific specimens.
8) RETURN to screen 8.
9) RETURN to main menu.

Your choice?

****

The J-R curve data are accessed from this menu. The listed options result in the following:

(1) Lists basic specimen information such as specimen type, orientation, side-groove percentage, specimen dimensions B and W, and test temperature. Proceed to Screen 18.

(2) Lists J_{Ic} and T_{mat} values, along with appropriate flow stress and elastic modulus values. Proceed to Screen 19.

(3) Lists calculated J-R curve $(J-\Delta a)$ data. Proceed to Screen 16.

(4) Lists raw data and calculated values for each J-R curve point. Proceed to Screen 15.

(5) Not available yet. Returns to Screen 14.

(6) Lists all of the specimen dimension information. Proceed to Screen 21.

(7) Lists specimen and test condition details for the selected heats, to allow the user to select specific specimens. Proceed to Screen 22.

(8) Returns to Screen 8.

(9) Returns to the Main Menu.

To make a selection, input the appropriate number followed by <RET>.

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```
REF #:     1     SPECIMEN NUMBER: ZP13-1LC
LOAD:                407.8
DEFLECTION: Uncorrected: 0.00272      Corrected: 0.00272
TOTAL AREA:              0.04
SLOPE/POTENTIAL:   0.0000003139
COMPUTED a:        0.000000          POST TEST a  0.422240
J1:                  13.94           J2:            13.94
DELTA A:           0.000587

REF #:     1     SPECIMEN NUMBER: ZP13-1LC
LOAD:                614.2
DEFLECTION: Uncorrected: 0.00807      Corrected: 0.00807
TOTAL AREA:              0.30
SLOPE/POTENTIAL:   0.0000003131
COMPUTED a:        0.000000          POST TEST a  0.422232
J1:                  91.69           J2:            91.70
DELTA A:           0.000579

                                Press a key to continue.
```

Raw data and calculated values for each J-R curve data point are given here. The listed values are:

LOAD Measured load applied to the specimen, in lb or kN.

DEFLECTION Measured deflection of the specimen ("uncorrected") or the deflection with adjustments ("corrected"), in in. or mm.

TOTAL AREA Calculated area under the load-loadline (or corrected) curve for use in J integral evaluation, in in.-lb or N-m.

SLOPE/ POTENTIAL Value of the crack length parameter, in in./lb or mm/kN for SLOPE or volts for POTENTIAL.

COMPUTED a Crack length values before the application of any post-test corrections, in in. or mm.

POST-TEST a Crack length values after all post-test corrections have been applied.

J1-J2 J integral values, in in.-lb/in.^{2} or kJ/m^2. Currently, J1 is deformation theory J (J_D) while J2 is modified J (J_M).

DELTA A Crack growth equal to POST-TEST a minus the initial crack length, in in. or mm.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 14.

If all of the data have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 14.

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SCREEN 16

REF	SPECIMEN NUMBER	J1	J2	Delta-a
1	ZP13-1LC	13.94	13.94	0.000587
1	ZP13-1LC	91.69	91.70	0.000579
1	ZP13-1LC	175.65	176.10	0.002031
1	ZP13-1LC	304.48	305.97	0.003154
1	ZP13-1LC	496.32	500.59	0.004882
1	ZP13-1LC	704.48	712.34	0.005740
1	ZP13-1LC	917.75	937.18	0.009453
1	ZP13-1LC	1143.65	1169.07	0.010972
1	ZP13-1LC	1373.07	1404.73	0.012283
1	ZP13-1LC	1578.91	1641.25	0.017772
1	ZP13-1LC	1803.18	1881.93	0.020311
1	ZP13-1LC	2013.27	2123.18	0.024583
1	ZP13-1LC	2197.78	2363.27	0.031449
1	ZP13-1LC	2389.71	2605.39	0.035937
1	ZP13-1LC	2587.44	2845.80	0.041315
1	ZP13-1LC	2740.49	3069.74	0.048020
1	ZP13-1LC	2891.03	3336.35	0.058114
1	ZP13-1LC	3057.01	3630.61	0.068465
1	ZP13-1LC	3239.73	3961.76	0.079437
1	ZP13-1LC	3454.21	4276.26	0.086217

Press a key to continue.

****

The calculated J-R curve data are listed here. Currently, J1 is deformation theory J (J_D) and J2 is modified J (J_M), both in units of in.-lb/in.^{2} or kJ/m^2. Delta-a is the crack growth for the specimen at that point, in units of in. or mm.

If the bottom line prompt is "***PRESS A KEY TO CONTINUE***", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 14.

If all of the data have been displayed (indicated by a prompt of "***THAT'S IT***"), then pressing any key returns to Screen 14.

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SCREEN 17

Screen 17

These are your choices:

0) RETURN to main menu.
1) LIST programs.
2) LIST files.

Your choice?

Actual dates of the last data file and software updates are given here. The listed selections result in:

(0) Returns to the Main Menu.

(1) Lists the software updates, then returns to Screen 17.

(2) Lists the data file updates, then returns to Screen 17.

To make a selection, input the appropriate number followed by <RET>.

BEST COPY AVAILABLE

Screen 18

```
Are you going to save this listing in a file? (NO) ?
 REF    SPECIMEN ID          TYPE   ORIENT   SG      B       W      TEMP
   1  ¦  ZP13-1CL             CT      CL     20%   0.228   0.799    550
   1  ¦  ZP13-1LC             CT      LC      0%   0.228   0.799    300
   1  ¦  ZP13-2CL             CT      CL     20%   0.228   0.799    550
   1  ¦  ZP13-2LC             CT      LC      0%   0.228   0.799    300
   1  ¦  ZP13-3LC             CT      LC      0%   0.228   0.799    550
   1  ¦  ZP13-4LC             CT      LC      0%   0.228   0.799    550
   1  ¦  ZP13-7LC             CT      LC     20%   0.228   0.799    550
   1  ¦  ZP13-8LC             CT      LC     20%   0.228   0.799    550

That's it.
Press a key to return to screen 14.
```

Basic specimen information is listed here. Specific information includes:

REF	The reference number for the specimen.
SPECIMEN ID	The specimen identification code.
TYPE	Specimen type, generally either CT or 3PBB.
ORIENT	The crack-plane orientation per ASTM E 399.
SG	The side-grooving percentage.
B	The specimen thickness, in in. or mm.
W	The specimen width, in in. or mm.
TEMP	The test temperature, in °F or °C.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 14.

If all of the data have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 14.

BEST COPY AVAILABLE

Screen 19

Are you going to save this listing in a file? (NO) ?

REF	SPECIMEN ID	TYPE	ORIENT	TEMP	Jic	Tmat	FLOW	Y.MOD
1	ZP13-1CL	CT	CL	550	278	41.0	49.30	27.67
1	ZP13-1LC	CT	LC	300	2298	364.0	49.50	28.82
1	ZP13-2CL	CT	CL	550	323	103.0	49.30	27.67
1	ZP13-2LC	CT	LC	300	1892	395.0	49.50	28.82
1	ZP13-3LC	CT	LC	550	2596	518.0	49.30	27.67
1	ZP13-4LC	CT	LC	550	2214	411.0	49.30	27.67
1	ZP13-7LC	CT	LC	550	1566	227.0	49.30	27.67
1	ZP13-8LC	CT	LC	550	1394	282.0	49.30	27.67

That's it.
Press a key to return to screen 14.

Summary fracture tcughness data are listed here. Specifically:

REF The reference number for the specimen.

SPECIMEN ID The specimen identification code.

TYPE The specimen type, generally either CT or 3PBB.

ORIENT The specimen orientation per ASTM E 399.

TEMP The test temperature, in °F or °C.

Jic The J_{Ic} or J initiation value, in in.-lb/in^2 or kJ/m^2.

Tmat The average tearing modulus value between the 0.15- and 1.5-mm offset exclusion lines per ASTM E 813.

FLOW The appropriate flow stress for the specimen, in ksi and MPa.

Y.MOD The appropriate elastic or Young's modulus for the specimen, in 10^3 ksi or GPa.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 14.

If all of the data have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 14.

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Screen 21

```
REF #: 1    ZP13-1CL
Orientation:        CL
Design code:          2
 Spec description:
B:   0.2    W:   0.8    H:   1.0
Notch depth:          0.0   Notch height, N:    0.0
Notch root angle:     0     Notch root radius:  0.000
Total SG depth:       0.05
SG angle:             0.0   SG root radius:     0.0
CG attachment:
Load line distance:   0.00
Edges distance:       0.10
Test temperature:   550
```

Press a key to continue.

Specimen dimensional information is listed here. The values given are:

REF #	The reference number for the specimen followed by the specimen identification code.
Orientation	The crack plane orientation per ASTM E 399.
B	The specimen thickness, in in. or mm.
W	The specimen width, in in. or mm.
H	The dimension in the third direction, in in. or mm.
Notch depth	The machined notch depth, in in. or mm.
Notch height, N	The machined notch height, in in. or mm.
Notch root angle	The machined notch root angle.
Notch root radius	The machined notch root radius, in in. or mm.
Total SG depth	The total depth of side grooves, in in. or mm.
SG angle	The side-groove angle.
SG root radius	The side-groove root radius, in in. or mm.
CG attachment	Description of the clip gage attachment.

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Load line distance	Distance between the specimen loadline and the clip gage attachments, in in. or mm.
Edges distance	Initial gage length, in in. or mm.
Test temperature	The test temperature, in °F or °C.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 14.

If all of the data have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 14.

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Choose specimens

Screen 22

#	SPECIMEN ID	TEMP	ORIENT	SG	B	W
1)	ZP13-1CL	550	CL	20%	0.228	0.799
2)	ZP13-1LC	300	LC	0%	0.228	0.799
3)	ZP13-2CL	550	CL	20%	0.228	0.799
4)	ZP13-2LC	300	LC	0%	0.228	0.799
5)	ZP13-3LC	550	LC	0%	0.228	0.799
6)	ZP13-4LC	550	LC	0%	0.228	0.799
7)	ZP13-7LC	550	LC	20%	0.228	0.799
8)	ZP13-8LC	550	LC	20%	0.228	0.799

Enter the number of the specimen number you want to select.
Enter the negative of the same number to "un-select" the specimen number.
Just press <RET> when you are finished, or enter an X to return to screen 14.

Your choice?

****

This screen is used to select specific J-R curve data sets for listing purposes. As a guide, characteristics of the test, including the test temperature, orientation, and dimensional information, are given for each specimen.

As indicated, to select a specific specimen, the user should input the appropriate number followed by <RET>. (Example: "1 <RET>" selects specimen ZP13-1CL.) To delete an improper selection, input the negative of the number followed by <RET>. (Example: if specimen ZP13-1CL was an improper selection, input "-1 <RET>" to delete that selection.) As many selections as desired can be made, with only one entry per line. Once the proper selections have been made, just press <RET> (with no input) to proceed to Screen 18.

At all times, an input of "X <RET>" returns to Screen 14.

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SCREEN 23
Screen 23

Are you going to save this listing in a file? (NO) ?

REF	SPECIMEN ID	ORIENTATION	TEMP	YIELD	UTS	AREA RED.	ELONGATION
1	ZP13-1L	L	75	42.64	87.73	71	42
1	ZP13-2L	L	300	36.69	82.22	71	33
1	ZP13-3L	L	399	37.13	84.98	50	25
1	ZP13-4L	L	550	30.75	87.73	55	25
1	ZP13-5L	L	649	29.15	85.85	55	27
1	ZP13-6L	L	75	42.79	88.17	58	35
1	ZP13-7L	L	399	37.56	85.70	66	35
1	ZP13-8L	L	649	37.42	86.43	76	47
14	TIG-1	L	75	51.34	86.30	79	59
14	TIG-2	L	75	68.89	90.50	69	55
14	TIG-3	L	550	34.66	82.08	71	29
14	TIG-4	L	550	53.81	83.38	69	28

That's it.
Press a key to return to screen 12.

Summary results from tensile tests are listed here. The specific data listed are:

REF	The reference number for the specimen.
SPECIMEN ID	The specimen identification code.
ORIENTATION	The loading direction per ASTM E 399.
TEMP	The test temperature, in °F or °C.
YIELD	The yield stress, in ksi or MPa.
UTS	The ultimate tensile strength, in ksi or MPa.
AREA RED	The reduction of area, in percentage.
ELONGATION	The elongation, in percentage.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 12.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 12.

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SCREEN 24

Screen 24

Are you going to save this listing in a file? (NO) ?

REF	SPECIMEN ID	ORIENTATION	TEMP	ALPHA	N	Eo	SIGMA
1	ZP13-1L	L	75	0.0000	0.0000	0.000000	0.000
1	ZP13-2L	L	300	0.0000	0.0000	0.000000	0.000
1	ZP13-3L	L	399	0.0000	0.0000	0.000000	0.000
1	ZP13-4L	L	550	0.0000	0.0000	0.000000	0.000
1	ZP13-5L	L	649	0.0000	0.0000	0.000000	0.000
1	ZP13-6L	L	75	0.0000	0.0000	0.000000	0.000
1	ZP13-7L	L	399	0.0000	0.0000	0.000000	0.000
1	ZP13-8L	L	649	0.0000	0.0000	0.000000	0.000
14	TIG-1	L	75	0.0000	0.0000	0.000000	0.000
14	TIG-2	L	75	13.0000	4.0000	0.000000	68.893
14	TIG-3	L	550	0.0000	0.0000	0.000000	0.000
14	TIG-4	L	550	2.0000	11.0000	0.000000	53.809

That's it.

Press a key when ready to return to screen 12.

****

Ramberg-Osgood equation parameters are given for each specimen. The form of the equation used is:

$$\frac{\varepsilon}{\varepsilon_o} = \frac{\sigma}{\sigma_o} + \alpha \left(\frac{\sigma}{\sigma_o}\right)^n$$

Information listed on this Screen includes:

REF	The reference number for the specimen.
SPECIMEN ID	The specimen identification code.
ORIENTATION	The loading direction per ASTM E 399.
TEMP	The test temperature, in °F or °C.
ALPHA	The α value for the above equation.
N	The n value for the above equation.
Eo	The ε_o value for the above equation.
SIGMA	The σ_o value for the above equation.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 12.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 12.

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SCREEN 25

Screen 25

```
REF #: 1                                  Specimen #: ZP13-1L
Orientation: L                            Location:
STRAIN RATE:    Pre-yield:    0.000       Post-yield:    0.000
Gage length:  0.0000                      Fluence:       0.0
Temperature: 75
Yield strength:   42.84                   Analysis code: 1
Description of analysis method:
UTS:              67.73
Area reduction: 71                        Elongation: 42
Analysis method:

Ramberg-Osgood values:   0.0000   0.0000 0.000000   0.00
# of stress-strain points: 0
```

Press a key to continue.

****

All of the summary-type of information for each specimen are listed on this screen, with each screen containing all of the data for a single specimen. Specific information listed includes:

REF #	The reference number for the specimen.
Specimen #	The specimen identification code.
Orientation	The loading orientation per ASTM E 399.
Location	The specimen location in the parent material.
STRAIN RATE	The "Pre-yield" and "Post-yield" strain rates, in units of min^{-1}.
Gage length	The gage length used for elongation measurements.
Fluence	The neutron fluence, in n/cm^2 (E > 1 MeV).
Temperature	The test temperature, in °F or °C.
Yield strength	The calculated yield strength, in ksi or MPa.
Analysis code	The code for the analysis method used in determining the yield strength, with 1 = 0.2% offset, 2 = 0.5% total strain, and 3 = other.
Description of the analysis method	A description of the "other" analysis method for determining yield strength.

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UTS	The ultimate tensile strength, in ksi or MPa.
Area reduction	The reduction of area percentage.
Elongation	The elongation percentage.
Analysis	Description of the method used to determine true σ-ε data.
Ramberg-Osgood values	In order, the α, n, ε_o, and σ_o from the Ramberg-Osgood equation (see Screen 24).
# of stress-strain points	The number of σ-ε points stored in PIFRAC.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 12.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 12.

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SCREEN 26

Screen 26

REF	SPECIMEN ID	ORIENTATION	TEMP	ENGINEERING STRESS	ENGINEERING STRAIN	TRUE STRESS	TRUE STRAIN
1	ZP13-1L	L	75	4.49	0.0002	4.49	0.0002
1	ZP13-1L	L	75	4.57	0.0002	4.57	0.0002
1	ZP13-1L	L	75	4.39	0.0001	4.39	0.0001
1	ZP13-1L	L	75	8.50	0.0002	8.50	0.0002
1	ZP13-1L	L	75	10.89	0.0004	10.89	0.0004
1	ZP13-1L	L	75	15.06	0.0005	15.06	0.0005
1	ZP13-1L	L	75	19.58	0.0006	19.59	0.0006
1	ZP13-1L	L	75	25.11	0.0008	25.12	0.0008
1	ZP13-1L	L	75	30.57	0.0009	30.59	0.0009
1	ZP13-1L	L	75	35.70	0.0011	35.73	0.0011
1	ZP13-1L	L	75	38.87	0.0015	38.92	0.0015
1	ZP13-1L	L	75	39.84	0.0019	39.91	0.0019
1	ZP13-1L	L	75	40.18	0.0023	40.27	0.0023
1	ZP13-1L	L	75	41.12	0.0028	41.23	0.0028
1	ZP13-1L	L	75	42.38	0.0033	42.51	0.0032
1	ZP13-1L	L	75	43.35	0.0039	43.51	0.0038
1	ZP13-1L	L	75	44.55	0.0044	44.74	0.0044
1	ZP13-1L	L	75	45.15	0.0050	45.38	0.0050
1	ZP13-1L	L	75	45.75	0.0056	45.99	0.0056
1	ZP13-1L	L	75	67.35	0.1866	79.90	0.1711
1	ZP13-1L	L	75	67.51	0.1978		
1	ZP13-1L	L	75	67.45	0.2093		
1	ZP13-1L	L	75	67.09	0.2213		
1	ZP13-1L	L	75	66.75	0.2338		
1	ZP13-1L	L	75	66.07	0.2468		
1	ZP13-1L	L	75	65.03	0.2601		
1	ZP13-1L	L	75	63.18	0.2735		
1	ZP13-1L	L	75	60.51	0.2870		
1	ZP13-1L	L	75	56.94	0.3007		
1	ZP13-1L	L	75	52.77	0.3146		
1	ZP13-1L	L	75	42.54	0.3365	131.33	1.2347

Press a key to continue.

Actual stress-strain data are listed on this Screen. Information listed on the Screen includes:

REF The reference number for the specimen.

SPECIMEN ID The specimen identification code.

ORIENTATION The loading direction per ASTM E 399.

TEMP The test temperature, in °F or °C.

ENGINEERING STRESS/STRAIN Engineering values of stress and strain, in ksi or MPa for stress.

TRUE STRESS/ STRAIN Values of true stress-strain, in ksi or MPa for stress.

For each row of data, the listed true and engineering values are determined from the same load-displacement point. Since equations to determine true stress and strain are generally applicable only up to

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maximum load, the true stress-strain columns are frequently empty after maximum load. However, such values generally are available at fracture, usually the last row of values.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 12.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 12.

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Screen 27

```
Are you going to save this listing in a file? (NO) ?
 REF   SPECIMEN ID          ORIENT   TEMP      Cv      EXP.    % SHEAR
   2 ¦ XP15-1CL             CL       -140      3.0     .001      0
   2 ¦ XP15-1LC             LC       -140      4.0     .000      0
   2 ¦ XP15-14CL            CL        -90      3.0     .001      0
   2 ¦ XP15-14LC            LC        -90      4.0     .000      0
   2 ¦ XP15-3CL             CL        -50      6.0     .002      0
   2 ¦ XP15-3LC             LC        -50      5.0     .002      0
   2 ¦ XP15-17CL            CL          0      6.0     .002      0
   2 ¦ XP15-17LC            LC          0      6.0     .003      6
   2 ¦ XP15-12CL            CL         30     13.0     .007      6
   2 ¦ XP15-12LC            LC         30     15.0     .010     17
   2 ¦ XP15-10CL            CL         39     12.0     .005     12
   2 ¦ XP15-11CL            CL         50     14.0     .007      6
   2 ¦ XP15-11LC            LC         50     60.0     .025     47
   2 ¦ XP15-6CL             CL         71     20.0     .011     11
   2 ¦ XP15-6LC             LC         71     38.0     .017     23
   2 ¦ XP15-15CL            CL         71     16.0     .009     27
   2 ¦ XP15-15LC            LC         71     60.0     .025     50
   2 ¦ XP15-7CL             CL        100     20.0     .010     27
   2 ¦ XP15-7LC             LC        100     66.0     .031     60
   2 ¦ XP15-16CL            CL        100     25.0     .015     45
                                  Press a key to continue.
```

Summary Charpy-V data are listed here. The specific information include:

REF	The reference number for the specimen.
SPECIMEN ID	The specimen identification code.
ORIENT	The crack plane orientation per ASTM E 399.
TEMP	The test temperature, in °F or °C.
Cv	Absorbed energy, in ft-lb or J.
EXP.	Lateral expansion, in in. or mm.
% SHEAR	The shear percentage.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 13.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key returns to Screen 13.

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Screen 28

Are you going to save this listing in a file? (NO) ?

REF	SPECIMEN ID	TYPE	ORIENT	LOCATION	FLUENCE	TEMP	Cv	EXP	SHEAR	VEL
2	XP15-1CL	1	CL		0.0	-140	3.0	.001	0	0.000
2	XP15-1LC	1	LC		0.0	-140	4.0	.000	0	0.000
2	XP15-14CL	1	CL		0.0	-99	3.0	.001	0	0.000
2	XP15-14LC	1	LC		0.0	-99	4.0	.000	0	0.000
2	XP15-3CL	1	CL		0.0	-50	6.0	.002	0	0.000
2	XP15-3LC	1	LC		0.0	-50	5.0	.002	0	0.000
2	XP15-17CL	1	CL		0.0	0	6.0	.002	0	0.000
2	XP15-17LC	1	LC		0.0	0	6.0	.003	6	0.000
2	XP15-12CL	1	CL		0.0	30	13.0	.007	8	0.000
2	XP15-12LC	1	LC		0.0	30	15.0	.010	17	0.000
2	XP15-18CL	1	CL		0.0	39	12.0	.005	12	0.000
2	XP15-11CL	1	CL		0.0	50	14.0	.007	6	0.000
2	XP15-11LC	1	LC		0.0	50	80.0	.025	47	0.000
2	XP15-8CL	1	CL		0.0	71	20.0	.011	11	0.000
2	XP15-8LC	1	LC		0.0	71	38.0	.017	23	0.000
2	XP15-16CL	1	CL		0.0	71	16.0	.009	27	0.000
2	XP15-15LC	1	LC		0.0	71	80.0	.025	50	0.000
2	XP15-7CL	1	CL		0.0	109	20.0	.010	27	0.000
2	XP15-7LC	1	LC		0.0	109	66.0	.031	60	0.000
2	XP15-16CL	1	CL		0.0	109	25.0	.015	45	0.000

Press a key to continue.

****

Detailed Charpy-V data are listed here. The specific information includes:

REF	The reference number for the specimen.
SPECIMEN ID	The specimen identification code.
TYPE	The specimen type, with 1=C_v and 2=DW.
ORIENT	The crack plane orientation per ASTM E 399.
LOCATION	The specimen location in the parent material.
FLUENCE	The neutron fluence, in n/cm^2 (E > 1 MeV).
TEMP	The test temperature, in °F or °C.
Cv	Absorbed energy, in ft-lb or J.
EXP.	Lateral expansion, in in. or mm.
SHEAR	The shear percentage.
VEL	Velocity of the hammer, in ft/s or m/s.

If the bottom line prompt is "*PRESS A KEY TO CONTINUE*", then pressing any key (except "X") results in a scroll to the next list of data. An input of "X" at this time returns to Screen 13.

If all heats have been displayed (indicated by a prompt of "*THAT'S IT*"), then pressing any key except "X" returns to Screen 13.

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5. LOG-OUT PROCEDURES

Once the user has completed his search through PIFRAC, an orderly log-out sequence should be followed. Log-out is accomplished by first routing to a Screen with an exit PIFRAC option. Such Screens are the Main Menu, Screen 1, and Screen 8. Upon reaching the desired Screen, make the proper selection to exit PIFRAC. The computer system will respond with "BYE". Echo this response by typing "BYE <RET>", and the log-out should be complete.

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REFERENCES

1. A. L. Hiser, "Piping Fracture Mechanics Data Base," in Proceedings of the U. S. Nuclear Regulatory Commission Thirteenth Water Reactor Safety Research Information Meeting, USNRC Conference Proceedings NUREG/CP-0072, Vol. 2, Feb. 1986, pp. 321-336.

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This Guide is the reference for use of the NRC's Piping Fracture Mechanics Data Base (PIFRAC), a computerized data base containing the material's property data for steels used in nuclear power plant piping. These data are for use by NRC regulators as required for structural integrity assessments of safety margins in nuclear piping. The data of primary utility in such assessments are fracture toughness (principally J-R curve) and tensile (stress-strain) data, but other characteristic data such as chemical composition and Charpy-V data are also provided where available.
This Guide describes PIFRAC as presently configured. Revisions, updates, and corrections to PIFRAC will require revisions to this Guide.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

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